DoD EPA DOE SERDP
Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

NETTS PROJECT/DEMONSTRATION SUMMARY

Title: The Effects of Higher Plants on the Bioavailability and Toxicity of Petroleum Contaminants in Soil

Lead PI/Affiliation: Purdue Univ.
Co-PI's/Affiliations: Purdue

Date/Duration:
Initiated - 07/97
Completed - 09/00

NCBC-17-97

Abstract:

Phytoremediation is an innovative treatment technology that employs plants and their associated microbiota, soil amendments, and agronomic techniques to remove, contain, or render harmless environmental contaminants. The technology exploits the natural hydraulic and metabolic processes of plants, resulting in passive, solar-driven treatment that provides a realistic opportunity to achieve regulatory compliance and improve the overall ecological health of the site. The natural processes associated with living plants make them ideal for use in the remediation of selected contaminants in soil and groundwater.

The root and surrounding soil is a unique ecosystem referred to as the rhizosphere. Through their roots, plants secrete sugars, alcohols, organic acids, and other compounds (collectively known as exudates) that are utilized by microorganisms in the rhizosphere. Some of the exudates may promote the growth and activity of bacteria and fungi that degrade pesticides, chlorinated hydrocarbons, and fuel hydrocarbons that are present in the soil.

Purdue University is conducting an evaluation of phytoremediation at the National Test Site in Port Hueneme, CA. The field test was set up as a randomized block design consisting of six replicates of three different treatments using: (1) white clover and tall fescue, (2) indigenous California grass species, and (3) an unvegetated control. Mixes of plants are being evaluated to identify plant traits that promote the remediation of diesel fuel to an acceptable endpoint. Experiments in progress will:

- Develop methods to rapidly assess bioavailability of more recalcitrant and potentially toxic soil contaminants for use as an acceptable endpoint.
- Examine how different root types and their associated rhizosphere affect contaminant bioavailability, toxicity, and the overall effectiveness of bioremediation and phytoremediation.
- Investigate the fate of petroleum hydrocarbons in plant/soil systems.
- Quantify the impact of weathering on contaminant bioavailability and toxicity.
- Assess changes in the rhizosphere microbial community associated with plants established in contaminated soil.

Results/Conclusions:

The results of this project will be used to provide guidance for selecting plant species and determining an acceptable endpoint based on bioavailability.

Publications/Presentations:

(1) Banks, M. K., Schwab, A. P., Smith, J. S., Kulakow, P., and Miller K., "Evaluation of Bioavailability in the Field for Petroleum Contaminated Soil," Presented at the 14th Annual Conference on Contaminated Soils, Amherst, MA, 1998. (2) Banks, M. K., "Microbial Changes During Phytoremediation of Petroleum Contaminants," Presented at the Exploring the Rhizosphere Workshop, IBC Phytoremediation Conference, Houston, TX, 1998. (3) Banks, M. K., "Bioavailability of Petroleum Contaminants in Vegetated Soil," Presented at the Annual West Coast Conference on Contaminated Soils and Groundwater, Oxnard, CA, 1998. (4) Banks, M. K., Schwab, A. P., Smith, J., Kim, R., Spriggs, T, Staton, K., Kulakow, P., and Liu B., "Phytoremediation of Petroleum Contaminated Soil: Field Assessment," Poster presented at the Battelle Fifth International Symposium on In-Situ and On-Site Bioremediation, San Diego, CA, 1999. (5) Schwab, A. P., and M. K. Banks, "Dissipation of Petroleum Contaminants in Vegetated Soil," Presented at the Annual West Coast Conference on Contaminated Soils and Groundwater, Oxnard, CA, 1999.